



Reactor Data at your Desk V2.0

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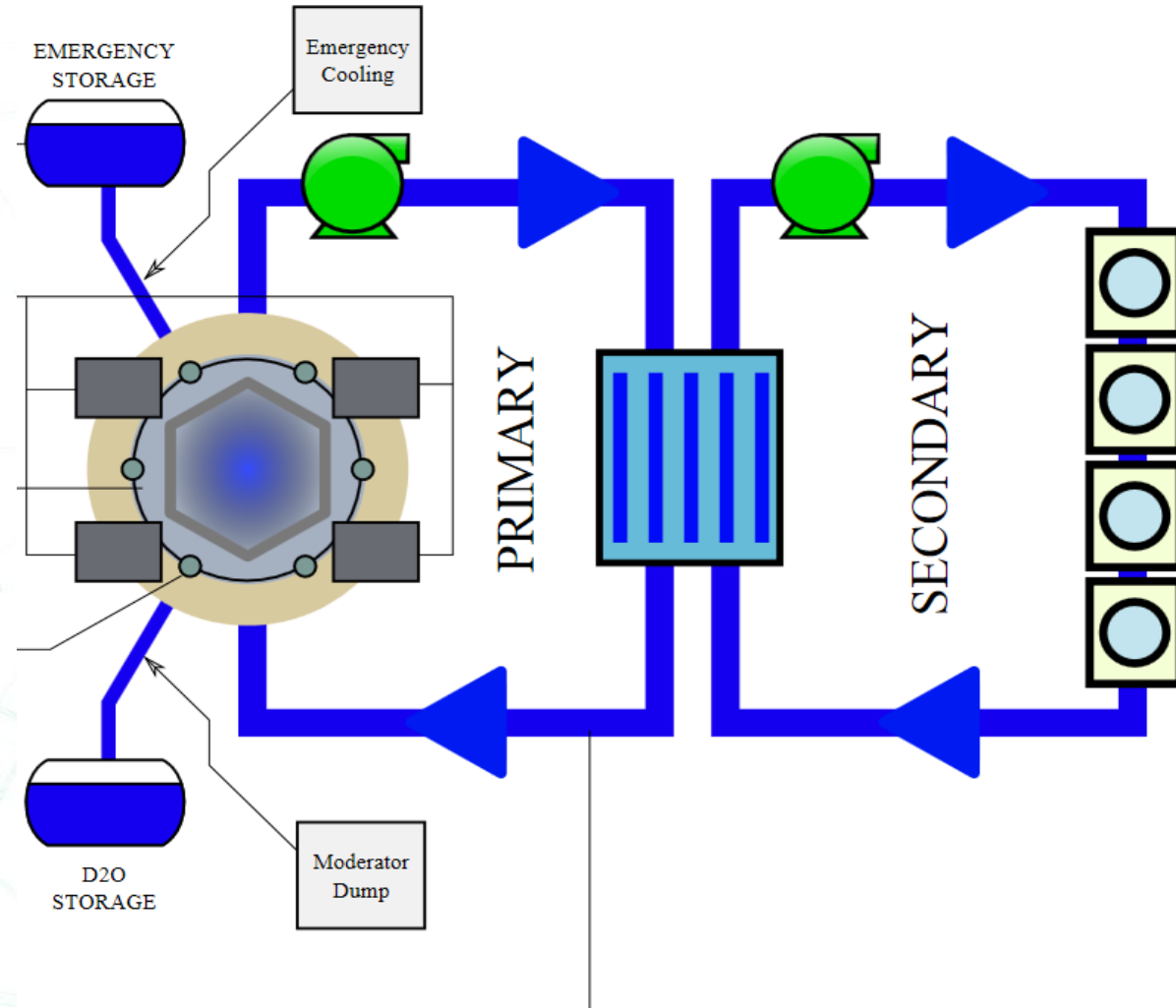
August 8th 2014



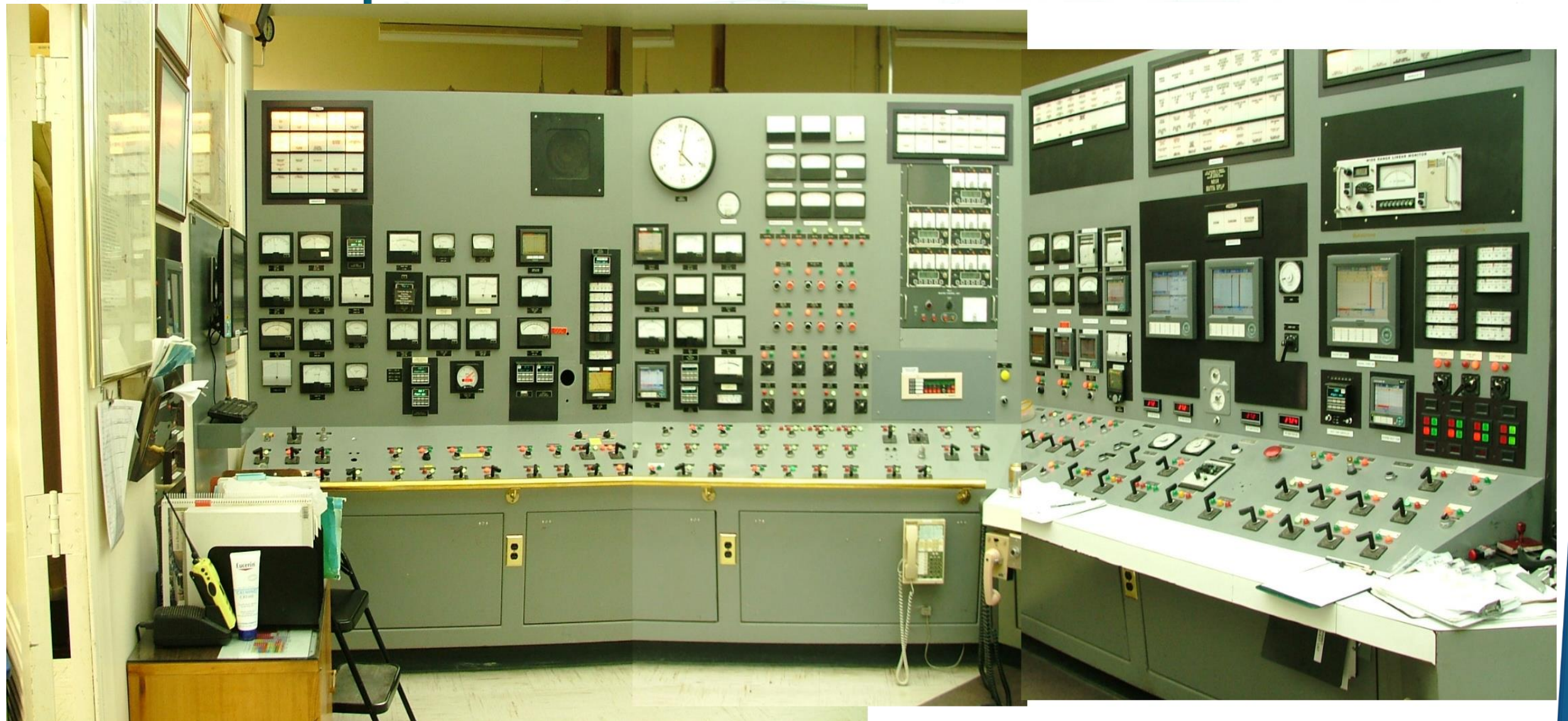
NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

Reactor Operations Engineering

- ▶ The National Bureau of Standard Reactor (NBSR) houses a 20MW research reactor
- ▶ NBSR facilitates thousands of research projects with this one reactor
- ▶ Reactor Operation Engineers goal is to keep reactor running for the researchers



Reactor Operations



Background

- ▶ Control Room Upgrade
 - Make reactor data more accessible
 - Improve Historical data for reactor
- ▶ Reactor Data at your Desk V1.0
 - C#.NET based Desktop application
 - Apache server based webpages (nbsr.nist.gov)

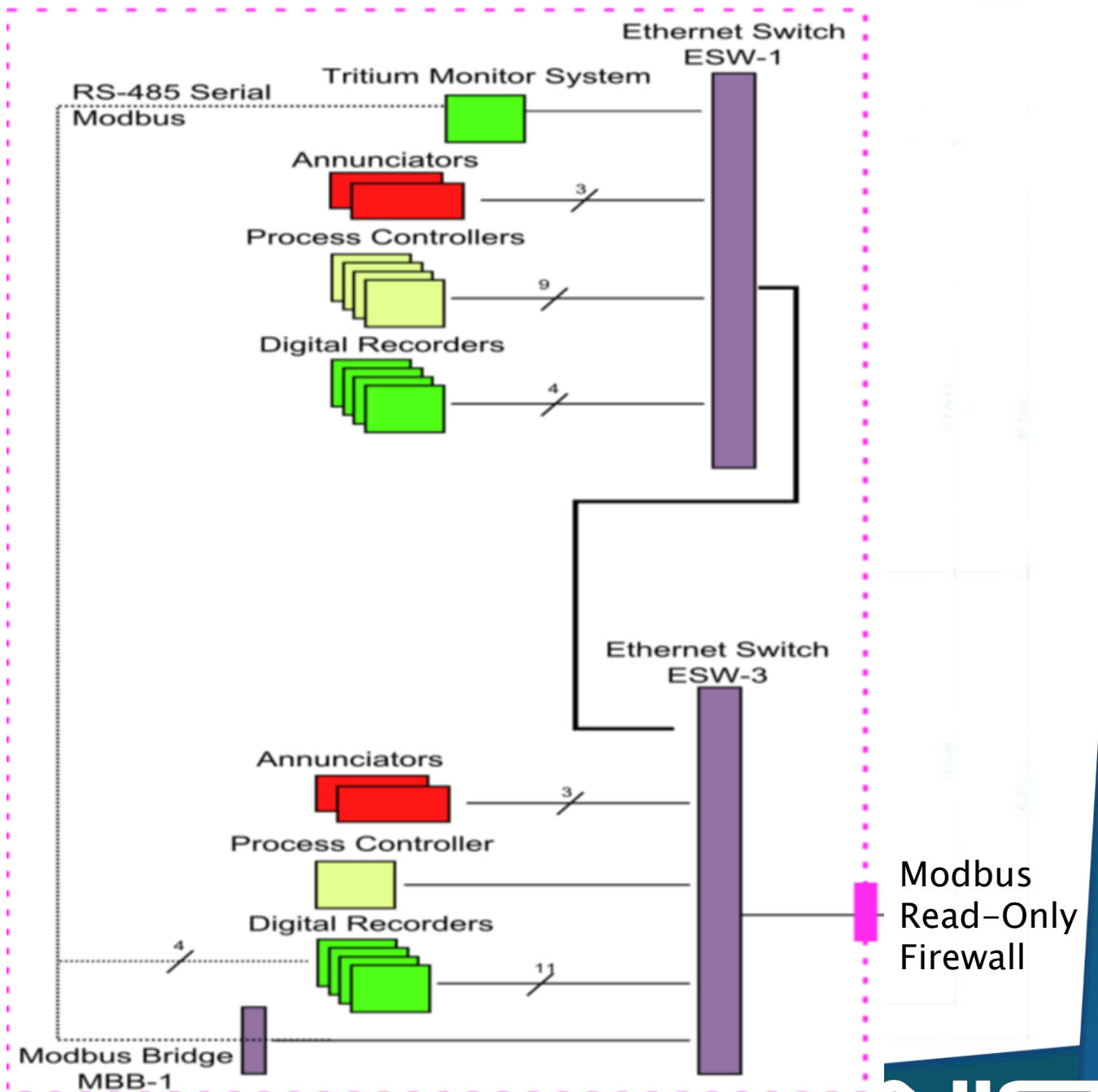
Requirements

- ▶ Monitor Major systems of the reactor
- ▶ Graph the reactors historical data
- ▶ Make it easy to use and access



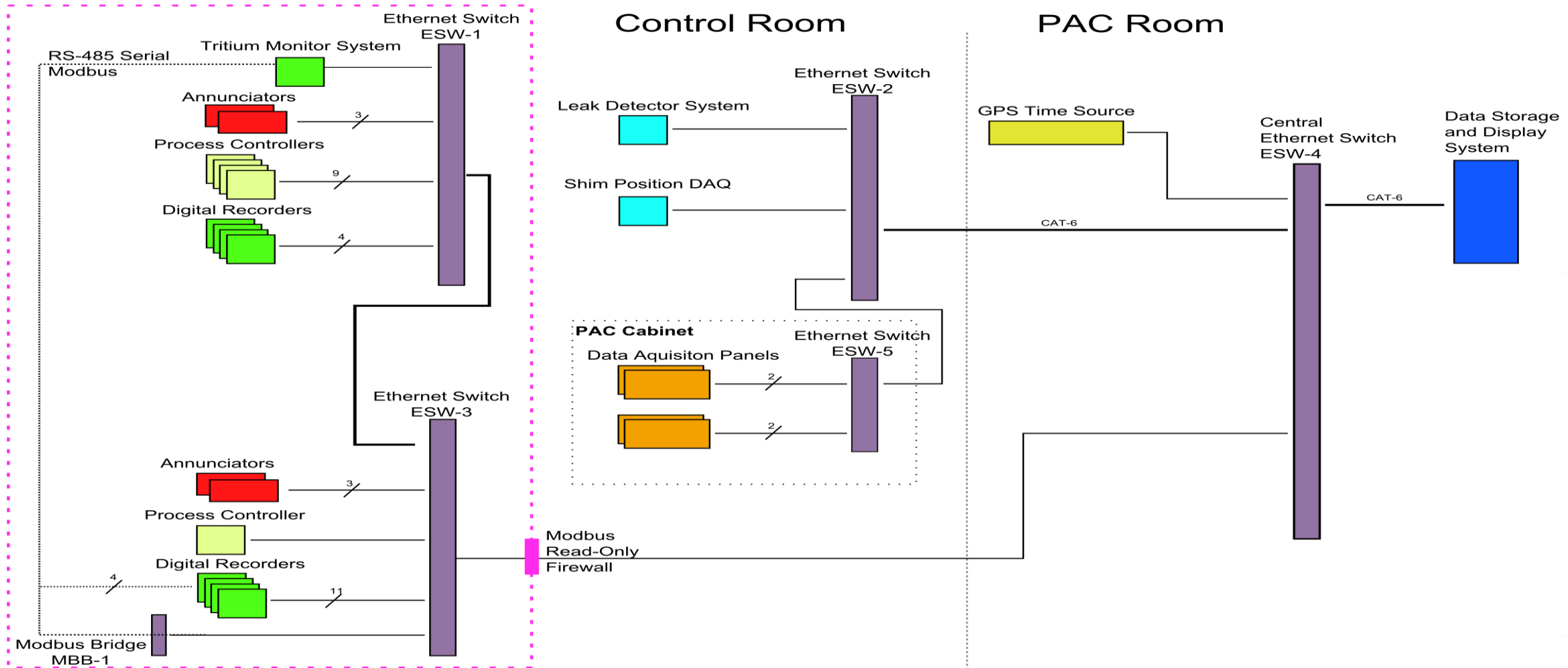
Data Acquisition

- ▶ Physical signal (current based) is converted to a digital form
- ▶ Data from the consoles and PAC panels are merged in a central Ethernet switch
- ▶ Data coming directly from the console is pushed through a read-only firewall



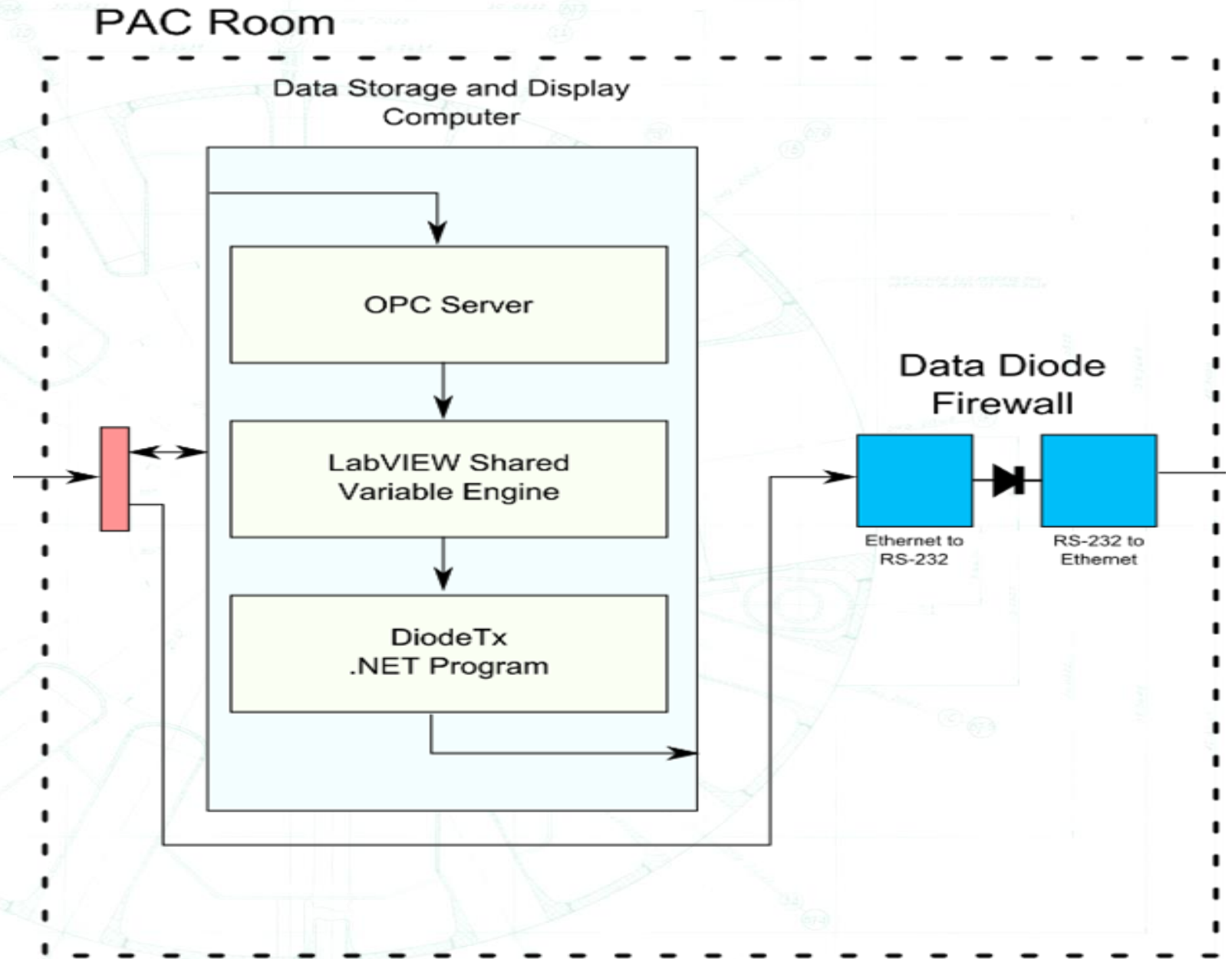
Data Acquisition

Network Architecture

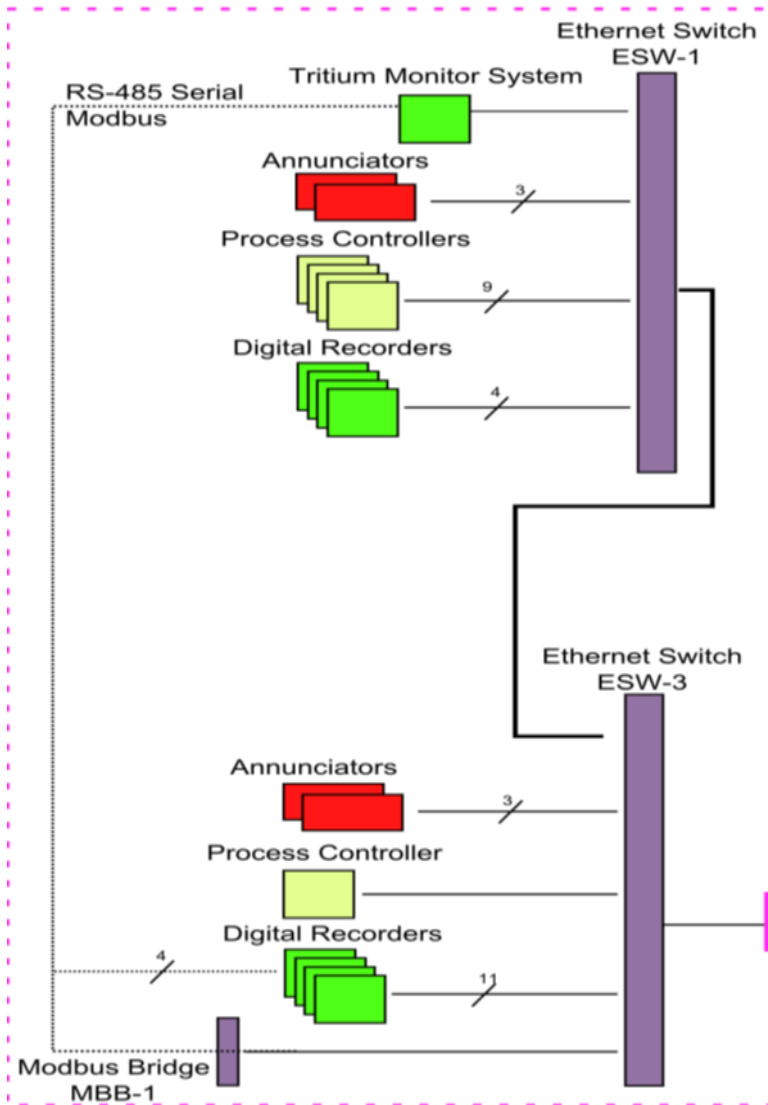


Data Handling

- ▶ Data sent through the firewall is received by a computer using an OPC server.
- ▶ Data is displayed on the PAC room consoles using labVIEW
- ▶ Data is formatted and pushed by DiodeTx, a C#.NET program, every 2 seconds



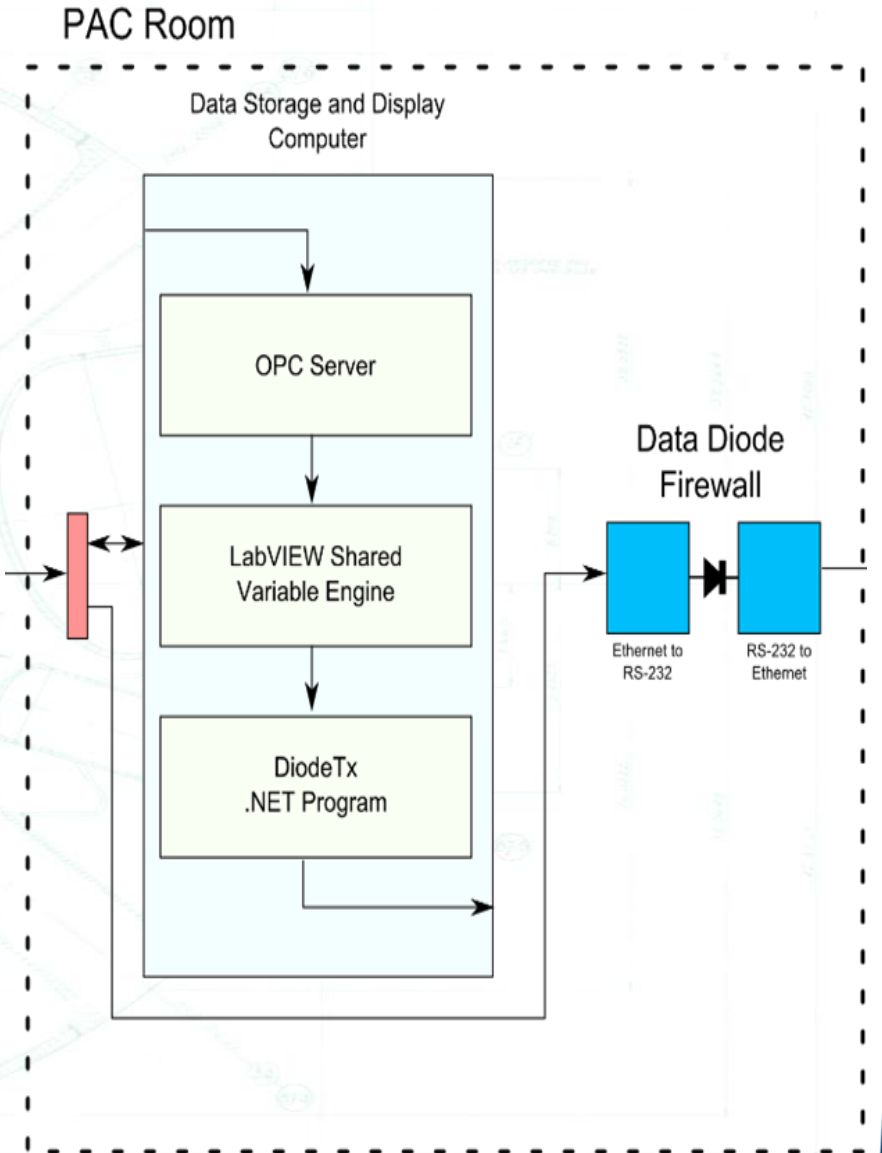
Security!



Data sent from the control room (left) is sent through a read-only firewall and the data acquisition systems are separate from the controls

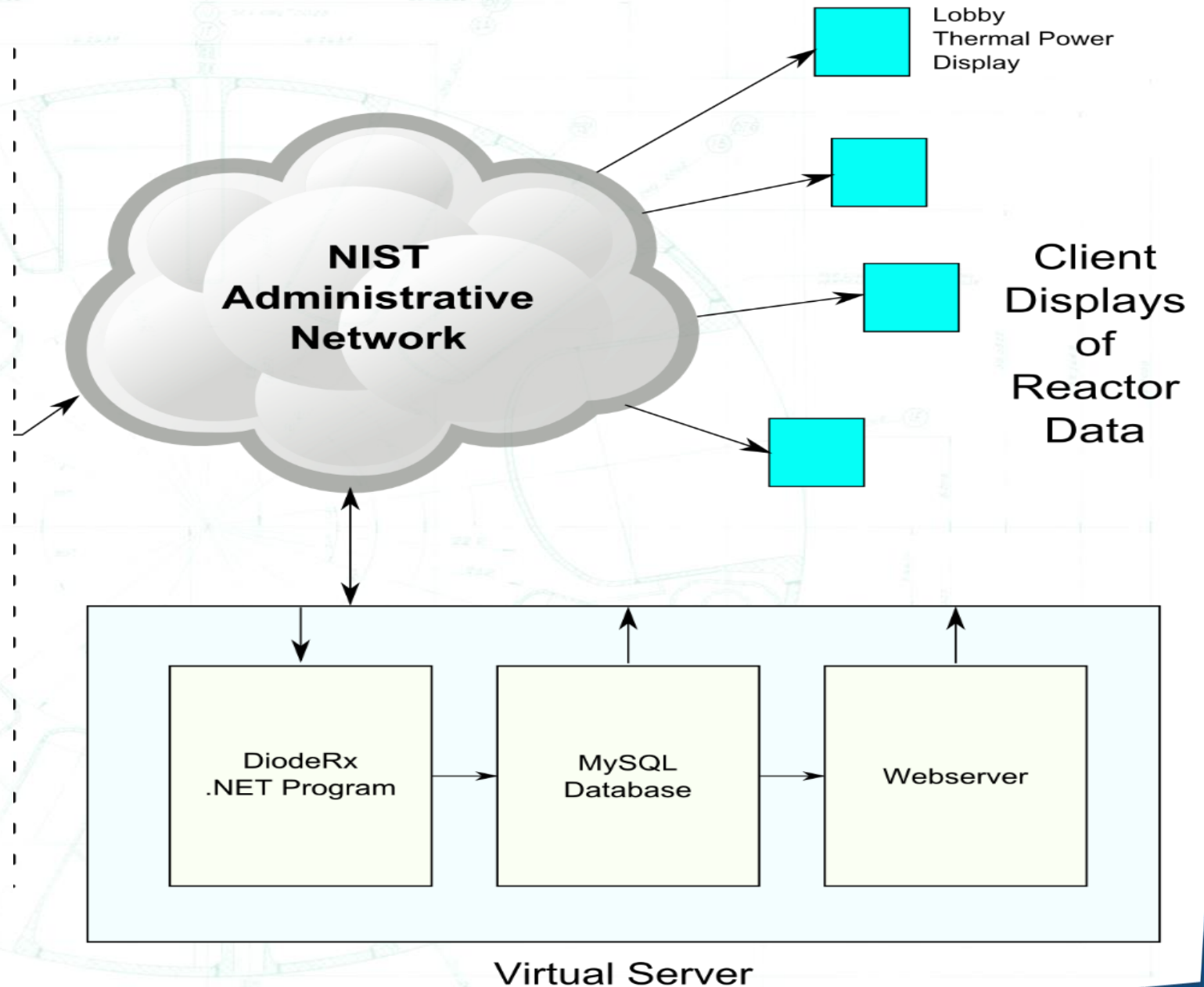


Data sent from the PAC room is sent through a one-way "Data Diode" to allow only a one directional flow of information.

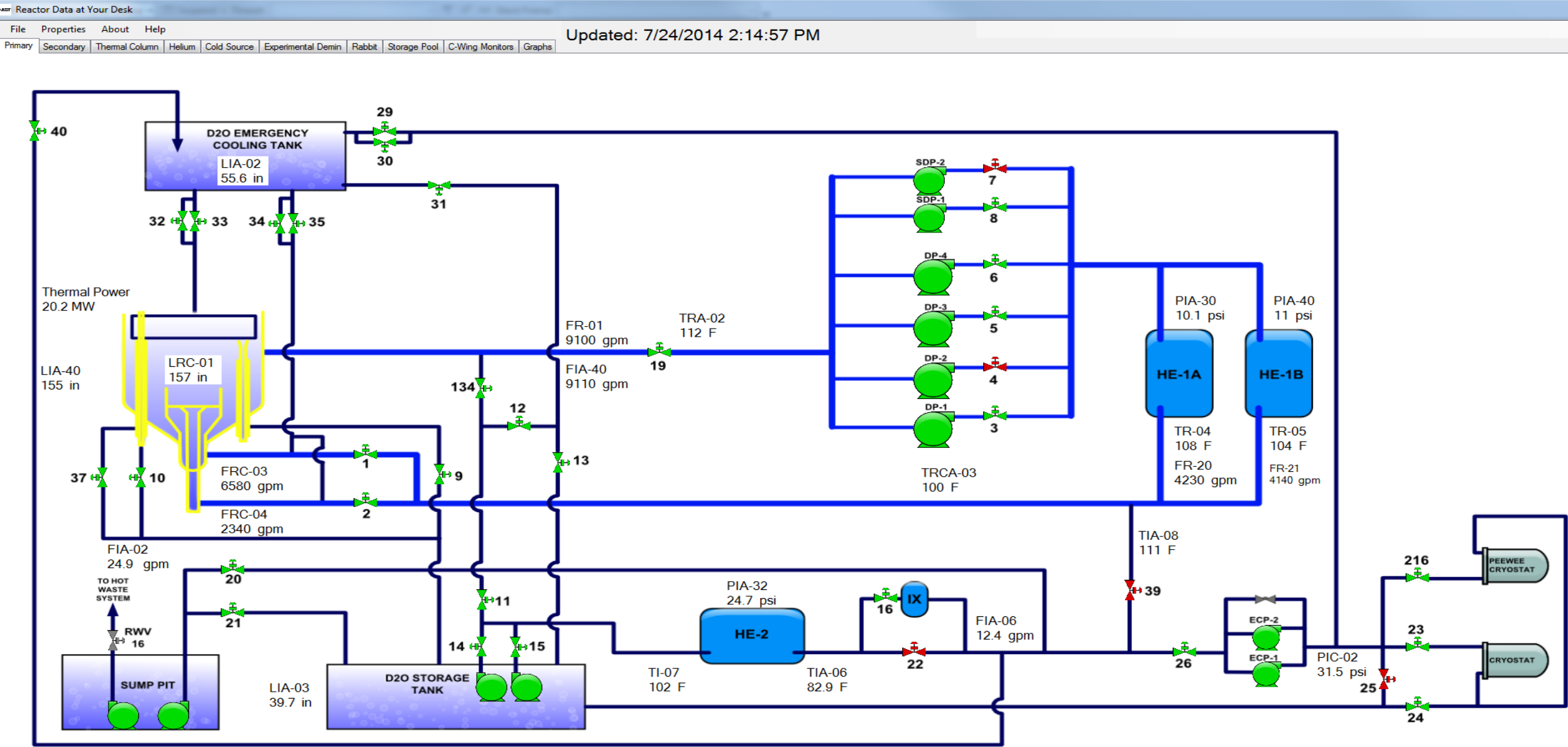


Data Handling

- ▶ Data is received by DiodeRx, another C#.NET program.
- ▶ Every 2 seconds DiodeRx formats the data and pushes it to the MySQL database.
- ▶ A historical log is made every 20 seconds by appending a table with the current values at that time.

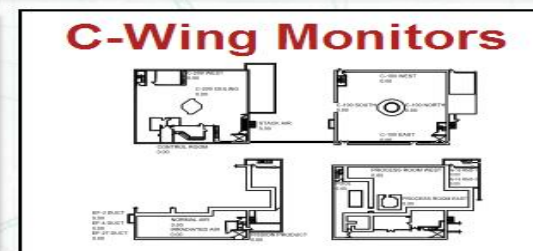
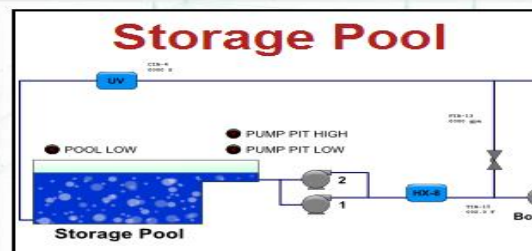
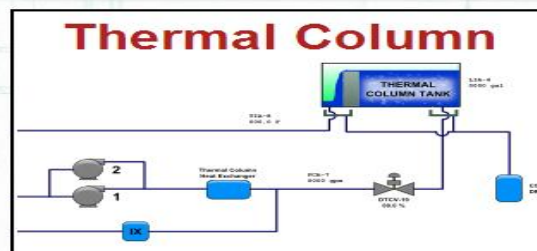
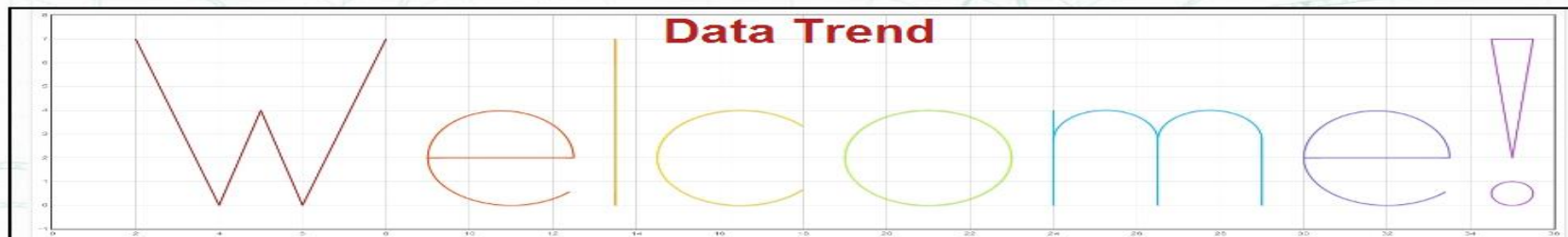
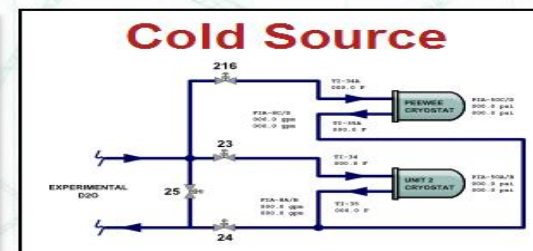
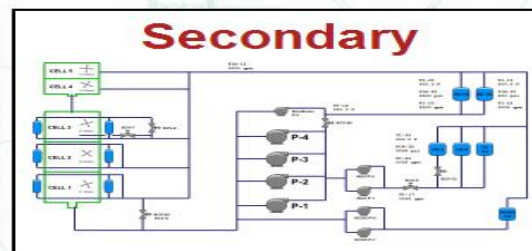
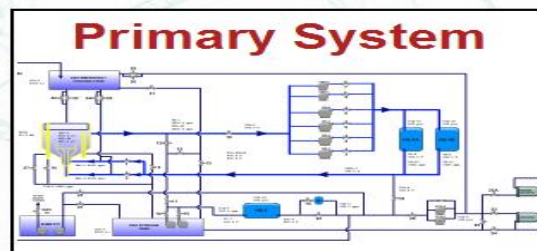


RD@D Desktop Display



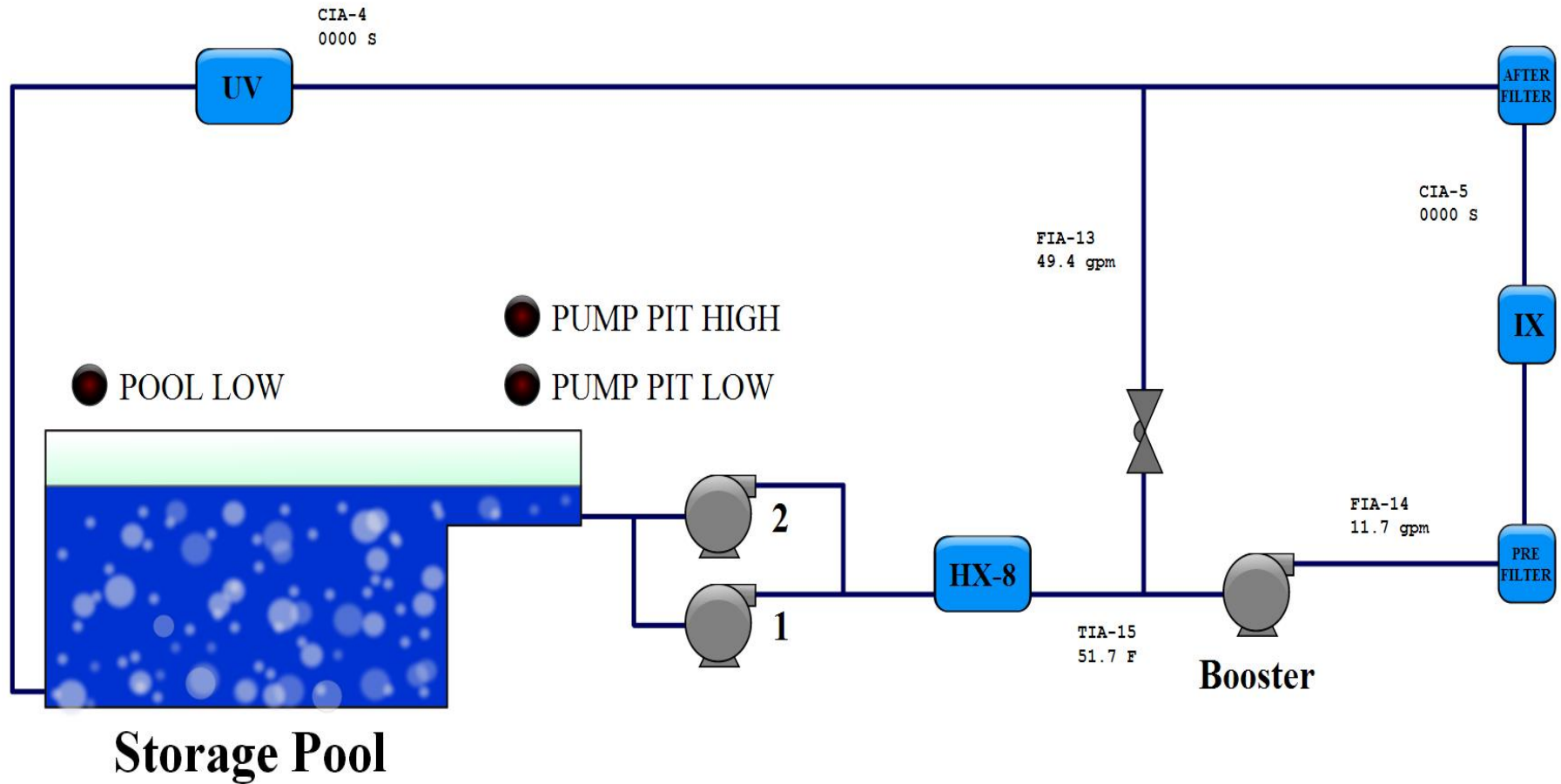
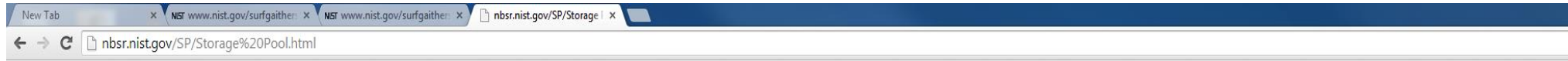
Welcome to Reactor Data at Your Desk

Click on an icon to view data for that system.



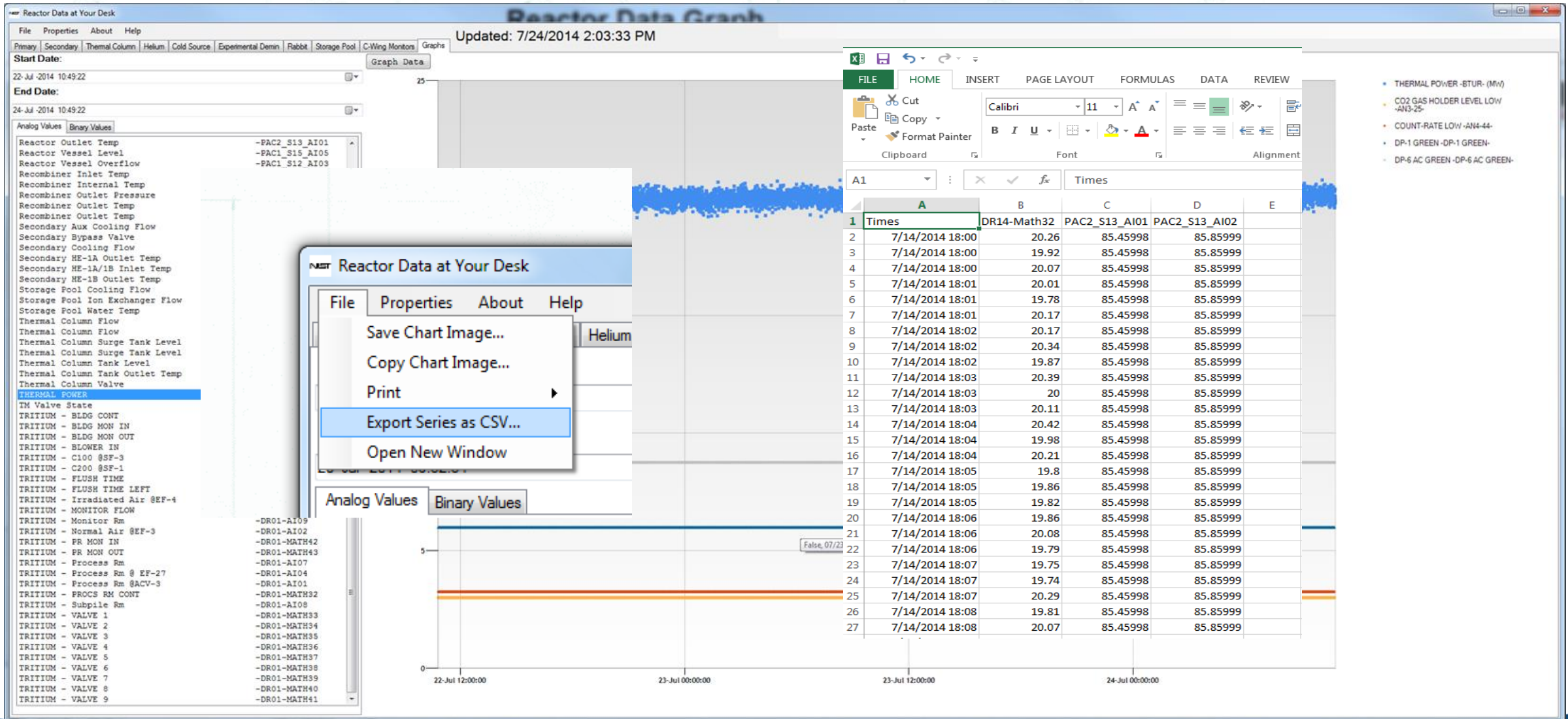
Official U.S. Time
03:13:06 p.m.
 Eastern (DST)
 12-hr 24-hr
 NIST network delay: 0.1 s

RD@D Mimics



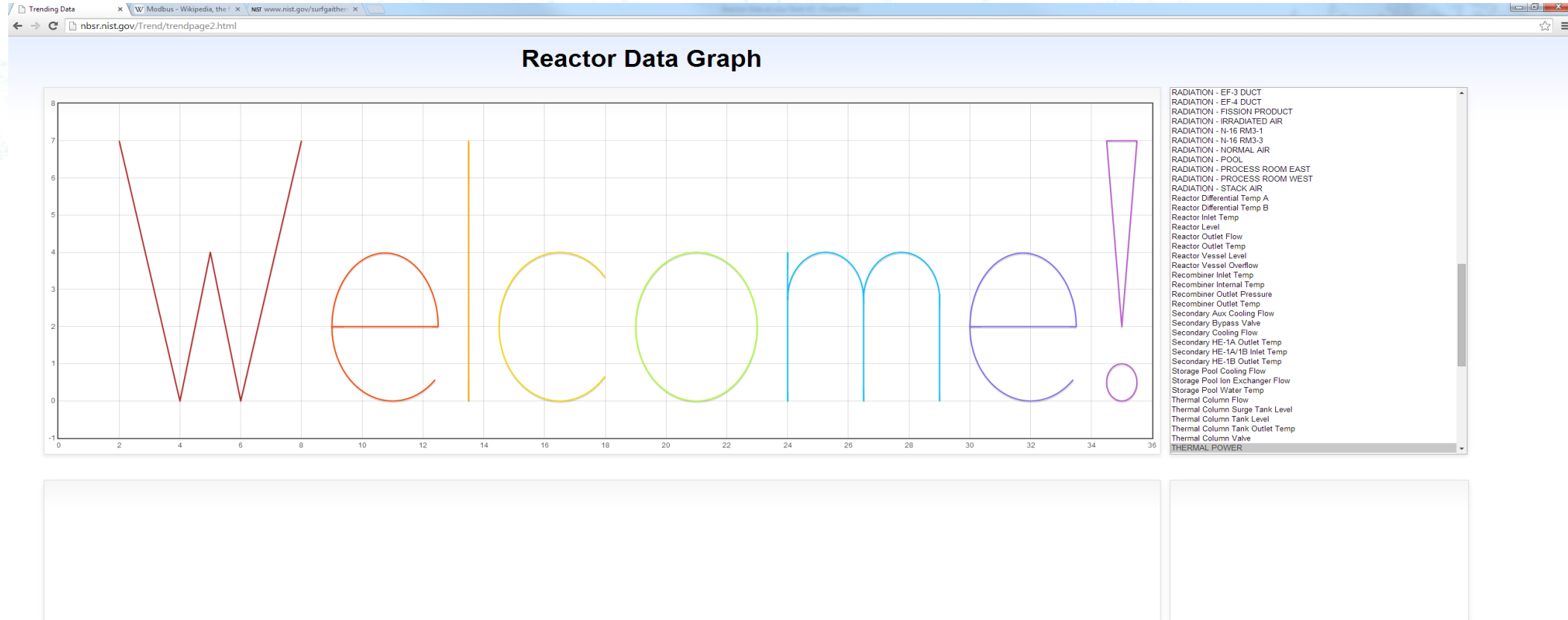
Desktop Trending

Exporting selected data points to a CSV file for use in a spreadsheet or other software to create a CSV file of analogue and binary values



RD@D Website Trending

nbsr.nist.gov



Date Format: YYYY-mm-dd HH:mm:ss

Enter start date: 2014-07-27 00:00:00

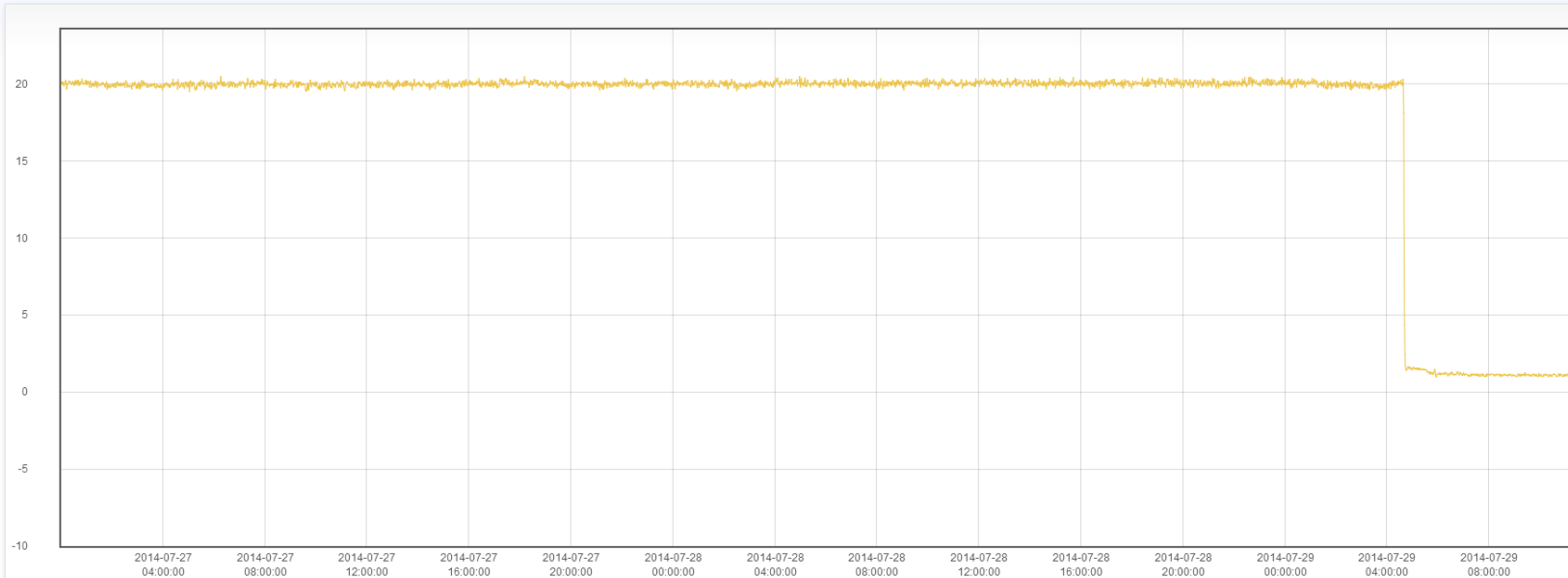
Enter end date: 2014-07-29 23:59:59

Graph Data

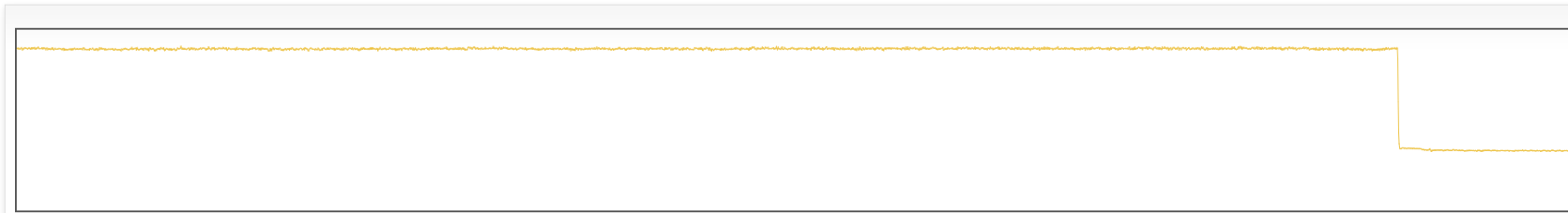
RD@D Website Trending

Trending Data x W Modbus - Wikipedia, the f x NIST www.nist.gov/surfgaither x
← → ↻ nbsr.nist.gov/Trend/trendpage2.html

Reactor Data Graph



RADIATION - EF-3 DUCT
RADIATION - EF-4 DUCT
RADIATION - FISSION PRODUCT
RADIATION - IRRADIATED AIR
RADIATION - N-16 RM3-1
RADIATION - N-16 RM3-3
RADIATION - NORMAL AIR
RADIATION - POOL
RADIATION - PROCESS ROOM EAST
RADIATION - PROCESS ROOM WEST
RADIATION - STACK AIR
Reactor Differential Temp A
Reactor Differential Temp B
Reactor Inlet Temp
Reactor Level
Reactor Outlet Flow
Reactor Outlet Temp
Reactor Vessel Level
Reactor Vessel Overflow
Recombiner Inlet Temp
Recombiner Internal Temp
Recombiner Outlet Pressure
Recombiner Outlet Temp
Secondary Aux Cooling Flow
Secondary Bypass Valve
Secondary Cooling Flow
Secondary HE-1A Outlet Temp
Secondary HE-1A/1B Inlet Temp
Secondary HE-1B Outlet Temp
Storage Pool Cooling Flow
Storage Pool Ion Exchanger Flow
Storage Pool Water Temp
Thermal Column Flow
Thermal Column Surge Tank Level
Thermal Column Tank Level
Thermal Column Tank Outlet Temp
Thermal Column Valve
THERMAL POWER



THERMAL POWER (MW)

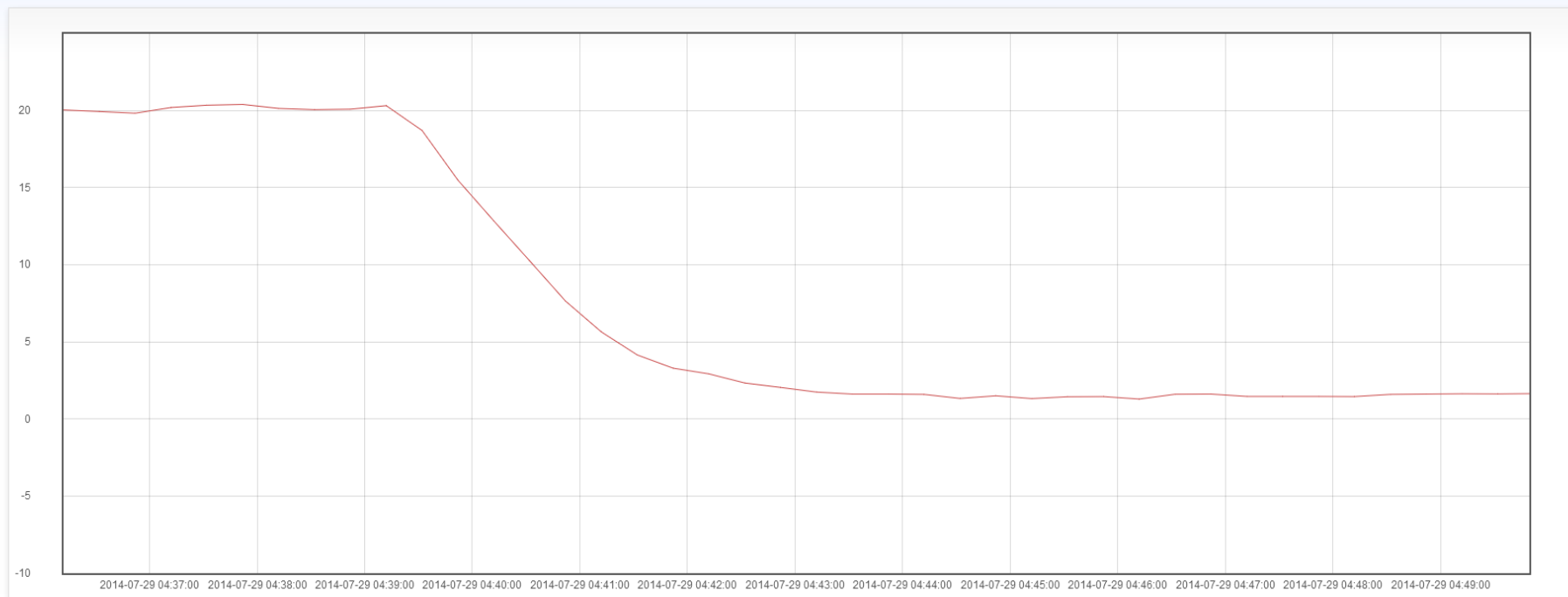
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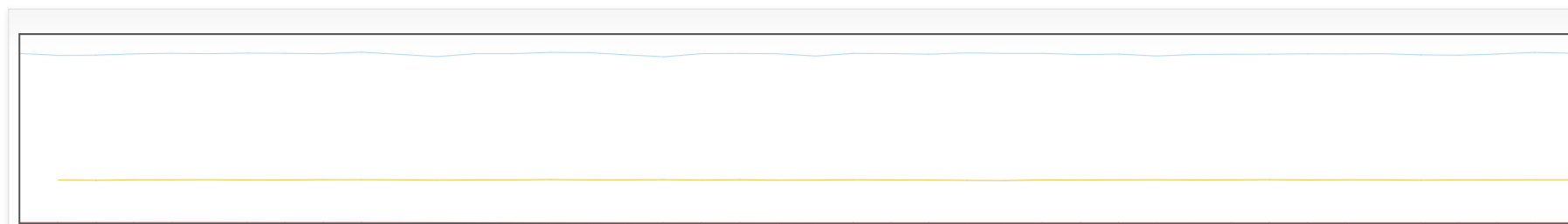
Enter end date: 2014-07-29 11:41:59

Graph Data

Reactor Data Graph



- BT-9 Cold Source Outlet Temp
- BT-9 Cold Source Pressure A
- BT-9 Cold Source Pressure B
- C2O Gas Holder Level
- Cold Source Flow A
- Cold Source Flow B
- Cold Source Inlet Temp
- Cold Source Outlet Temp
- Cold Source Pressure A
- Cold Source Pressure B
- Cooling Tower Level
- Cooling Tower Temp
- D2O Exp Cooling Pressure
- D2O Heat Exchanger HE-1A Outlet Temp
- D2O Heat Exchanger HE-1B Outlet Temp
- D2O Heat Exchanger HE-2 Inlet Temp
- D2O Heat Exchanger HE-2 Outlet Temp
- D2O Injection Flow
- D2O Ion Exchanger Flow
- D2O Ion Exchanger Inlet Conductivity
- D2O Storage Tank Level
- DCV-01
- DWV-25
- Emergency Cooling Tank Level
- Exp Demin H2O Heat Exchanger Inlet Temp
- Exp Demin H2O Heat Exchanger Outlet Temp
- Exp Demin H2O Pressure
- Exp Demin Water Tank Level
- FR-01
- HE-1A Pri-Sec Differential Pressure
- HE-1B Pri-Sec Differential Pressure
- HE-2 Outlet Temp
- Helium Compressor Secondary Flow
- Helium Flow
- Helium Gas Holder Level
- Inner Plenum Flow
- NC-3 LINEAR POWER
- NC-3 LOG POWER



- Inner Plenum Flow (gpm)
- Reactor Outlet Flow (gpm)
- THERMAL POWER (MW)

Date Format: YYYY-mm-dd HH:mm:ss

Enter start date: 2014-07-29 04:36:12

Enter end date: 2014-07-29 04:49:49

Graph Data



The Next Step

- ▶ Step 1: Finish connecting the control room to the network
- ▶ Step 2: User Testing
- ▶ Step 3: Profit?

Acknowledgements

- ▶ Joe Reyenga
- ▶ Sam MacDavid
- ▶ Mike Middleton
- ▶ Mike Rowe
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